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ABSTRACT

A sequence of studies compared two types of discrimination formation: errorless learning and trial-and-error procedures. The subjects were three boys and five girls from a university preschool. The children performed the experimental tasks at a typical match-to-sample apparatus with one sample window above and four match (response) windows below. Each of the children performed eight tasks, each involving a fifty-two slide presentation in eight different sessions. The errorless and trial-and-error tasks were alternated. The task slides were pictures of geometric figures that were rotated at different angles from the sample orientation of 0 degrees. Results revealed that the design of the tasks was insufficient for the purposes of the experiment. No errorless learning occurred, because criterion discrimination was too difficult. Subsequent experimentation with adults indicated that the tasks were too similar to permit the desired comparisons. (MH)

TECHNICAL REPORT

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ERRORLESS ESTABLISHMENT OF A MATCH-TO-SAMPLE FORM DISCRIMINATION IN PRESCHOOL CHILDREN

I. A MODIFICATION OF ANIMAL LABORATORY PROCEDURES FOR CHILDREN
II. A COMPARISON OF ERRORLESS AND TRIAL-AND-ERROR DISCRIMINATION[1]

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Acquisition of color discriminations without errors and errorless transfer of discriminations have been adequately demonstrated with infrahuman organisms (Terrace, 1963a, 1963b, Moore and Goldiamond 1964) achieved a near-errorless form discrimination with preschool children using brightness as the fading technique. Sidman and Stoddard (1967) also demonstrated near-errorless discrimination acquisition with retardates on a circle-ellipse discrimination problem. Much emphasis is currently placed upon the application of errorless discrimination in programmed learning, including preacademic programming. Errorless or near-errorless learning has come to be preferred by many who are looking to the future of our educational practices. However, little attention has been given to the question of whether errorless discrimination should, in fact, be preferred to the traditional trial-and-error discrimination procedures, once the sole technique in laboratories and academic institutions. Further work of Terrace (1966) indicates that discriminations formed without the occurrence of errors are not necessarily resistant to forgetting, following subsequent discriminations acquired through trial-and-error procedures. Therefore, the present sequence of studies was designed to establish errorless tasks which could also be learned through traditional trial-and-error procedures and to compare these two types of discrimination formation along the dimensions of trials to acquisition, interference of intervening discrimination formations upon the originally formed discriminations, and generalization.

Subjects

The eight subjects, three boys and five girls, ranging in age from three-eight to five-five (mean age four-four), attended a university preschool. All could make a "same-different" discrimination, as determined from previous testing for other experimentation. Final selection of the subjects was based upon their adequate usage of the match-to-sample apparatus during an introductory training session.

Apparatus

A typical match-to-sample apparatus (Hively, 1964), with one sample window above and four match (response) windows below, was used. Stimuli slides (two x two) were projected on the reverse side of these windows by a Bell and Howell projector. A series of photocells, located on the reverse and left side of the response panel and shielded from the subject's

view, were activated by circles of light, coded on the stimulus slides to indicate the correct match for that stimulus presentation. A correct match, i.e., pushing the response window displaying a stimulus identical to that appearing in the sample window, resulted in the release of the photocell mechanism and the projector advanced to the next stimulus slide while simultaneously recording the response on counters and a six pen event recorder. Simultaneously, a reinforcer (marble) dropped from a universal feeder, through a plastic tube in the wall, and into a plastic container placed above the sample window and slightly above the subject's eye level. Each reinforcer was accompanied by noise of the apparatus and the marble hitting the plastic container and by the illumination of a green light to the left of the match windows. An incorrect match resulted in similar counting, recording and advancing of the projector, but not in any of the events paired with reinforcement (other than apparatus noise). All responses, latencies and durations were recorded on the counters and event recorder. Slide presentation rate was regulated by the subject's window pressing rate.

Procedures

The subjects were instructed in the use of the match-to-sample response panel during a training session. They were told that when the sample ("top") window was pressed the first time a picture would appear in that window. The window was pressed either by the experimenter or spontaneously by the subjects and it was indicated that a second press would result in the appearance of four more pictures in the lower response windows. The sample window was pushed the second time by the subjects, either spontaneously or upon prompting from the experimenter and stimuli appeared in the four match windows. The subjects were asked to choose one of the four pictures which looked "just like the picture up there" (top window was indicated). During this part of training only one match-window contained a picture (the other three were blank). When the correct response window was pressed the experimenter indicated that both the onset of the green light and the marble dropping into the container was because the subject was "right" and that was "very good". At this point the experimenter explained that all marbles could be exchanged for a toy at the end of the session, indicating a selection of toys located on a child size table next to the response panel. Subjects were asked to choose a toy for which they would like to work and it was set aside. If an incorrect or no response was made by a subject, the experimenter said, "This one looks just like this one (sample window), doesn't it? Press this window" (the correct match). Only after a correct response was made by the subjects for the next two to five slides, verbally reinforcing responses and prompting those subjects who hesitated in the window pressing sequence. After these slides the experimenter told the subjects she would wait "back here" (indicating behind the wall onto which the response panel was mounted) until the subject completed the task. The only other interaction the experimenter had with the subjects was if there was a long pause between presses. In this event she said (without coming in front of the wall), "go ahead".

When the task ended, the experimenter verbally reinforced the subjects for completing the task and gave the child his preselected toy. Subjects also received a red plastic token, exchangeable in the preschool classroom for various items and privileges. In the preschool tokens are given each time a child participated in a research project.

At the beginning of session two, after the subjects chose a toy, it was explained that the red light, located at the right of the match-windows, indicated nothing would happen if the 'windows' were pressed. While walking behind the panel the experimenter said, "Wait until the red light is out before you begin". The experimenter activated a switch on the relay panel located behind the wall, the red light went out, the apparatus was activated and she said, "You may begin". The subjects then begin the task. Each of the remaining seven sessions were identical to this second one.

Each subject performed eight tasks of fifty-two slides, four errorless and four trial-and-error, in eight different sessions. The errorless and trial-and-error tasks were alternated (see Figure 1) over a period of eight days with the exception of subjects 2, 4, 6 and 8 who did more than one task per day for days due to prior absences. Subjects 1, 3, 5 and 7 began with an errorless task and subjects 2, 4, 6 and 8 with a trial-and-error task.

The eight sets of task slides consisted of pictures of geometric figures (Figure 1). These figures were white on black backgrounds with the areas of the figures remaining constant across sets of slides. On the left side of each slide was the circle of light which activated the photocells. Correct matches were identical in form to sample figures but were rotated at 135°, 180° or 215° angles from the sample orientation of 0°. Distractor figures were rotated at 45°, 180° or 315° angles from the sample orientation and were mirror images of correct responses. This rotation procedure was designed to make the task more difficult.

The trial-and-error tasks consisted of twenty slides (with one sample and four match pictures) which were identical to the criterion slides of the errorless task. This means that the distractors differed from the correct match only in their angle of rotation and because they were mirror-images of the sample. Each session consisted of a fifty-two slide presentation. Therefore, the twenty slides were shown in a forward sequence once, in a reverse sequence once, and again in a forward sequence until fifty-two slides were shown. The first trial-and-error slide was seen twice by the subject, slides two through fourteen were seen three times, slides sixteen through nineteen were seen twice and slide twenty was seen once.

In all errorless tasks the sample-figure and the correct-match were always at full illumination. The first three slides in each errorless task consisted of a sample-figure, match-figure and three blank match-windows. In the second three slides an illumination fade sequence was begun. Distractors were present but were very dark (close to the intensity

of the black background) and quite different in form from the sample. Slides seven-nine depicted distractors identical in form to those of slides four-six but their intensity was increased in order to begin decreasing the illumination differences between the distractors and the correct match through fading (Figure 1).

Following the color fade sequence three probe slides appeared. These probe slides were identical to the slides shown in the corresponding trial-and-error tasks and to the criterion slides for that errorless task.

The next fading sequence (physical-fade) consisted of a series of twenty-two slides with distractors which were initially near-rectangular in shape. The area of the distractors was gradually decreased to more closely approximate the form of the sample. This was done by the removal of an area 3/8" square from each distractor (Figure 1) on each succeeding slide until distractors were exact mirror-images of the correct matches and, thus, identical to the trial-and-error slides. The first nine physical fade slides were displayed in succession, followed by three probe slides. The second nine were also followed by three probes. The last four physical-fade slides preceded the last twelve slides which were the criterion slides of the errorless tasks. These were identical to the slides in the trial-and-error sets.

Results

The results primarily indicated that the tasks for this study were not sufficiently designed to provide the necessary errorless performance of preschool subjects. Figure 2 shows that performance on the last twelve criterion slides for both errorless and trial-and-error tasks didn't indicate that discrimination acquisition occurred. It can be further noted that there was no significant difference between criterion performance on errorless tasks and such performance on trial-and-error tasks.

In Figure 3, it can be seen that response errors were low during the programmed sequences and high during the criterion slide sequences for the same tasks, but the occurrence of these errors had no influence upon the subject's response latencies, i.e., there was no significant differences between response latencies during programmed (low error) sequences and those of the criterion (high error) sequences. Additionally, though an attempt was made to present the tasks to the subjects in what appeared (to the experimenter) to be increasing difficulty, there was no significant increase in errors across tasks.

Discussion

The difficulties involved in designing errorless or even near errorless tasks which will equip subjects to meet criterion performance is exemplified in this study. During the task designing stage emphasis was placed upon making the criterion discrimination as difficult as possible

in order to decrease generalizations from task to task, thus allowing for repeated comparison of errorless and trial-and-error discrimination acquisition within a single subject. This emphasis, however, resulted in a performance breakdown just prior to reaching criterion discrimination. Therefore, it will be necessary to redesign the entire programmed sequences because the present ones obviously did not include those steps necessary for establishing the criterion rotation, mirror-image discrimination for these children. Without such a sequence the dimensions of errorless and trial-and-error discrimination cannot be compared.

Additionally, further experimentaion with adults has indicated that the tasks involved are too similar to permit such comparisons because once the mirror-image, rotation discrimination is acquired during one task, it tends to generalize to the other tasks. When such occurs, there is no discrimination acquisition to compare because the succeeding tasks result in one trial learning. Therefore, the redesign of the stimulus sequences must also involve attempting to find tasks which are equated in difficulty but which do not generalize between themselves. Another alternative would be to design only one task and redesign the experiment using a groups design rather than a single subject.

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FOOTNOTES

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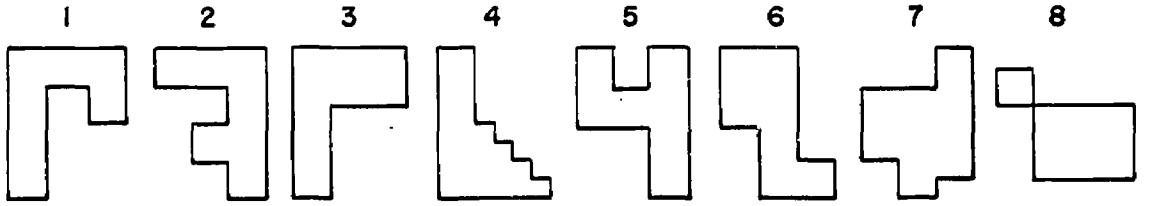
[2]This study was conducted while the author received support from a Research Training Program, NIH 5 T21 MHO 8262-05.

Task Figures Administered To Each S

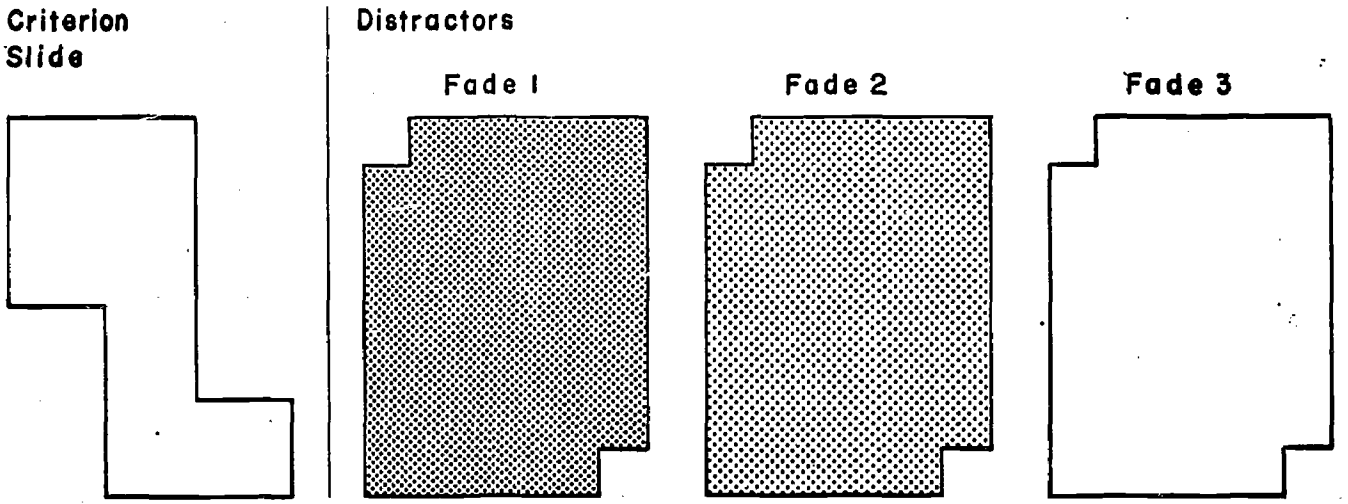
FIGURE 1



Subject	1	2	3	4	5	6	7	8
S_1-S_3-S_5-S_7	E	TE	E	TE	E	TE	E	TE
S_2-S_4-S_6-S_8	TE	E	TE	E	TE	E	TE	E

E: errorless
TE: trial and error

Example Of Distractors During Color Fade Sequence



Example Of Distractors During Physical Fade Sequence

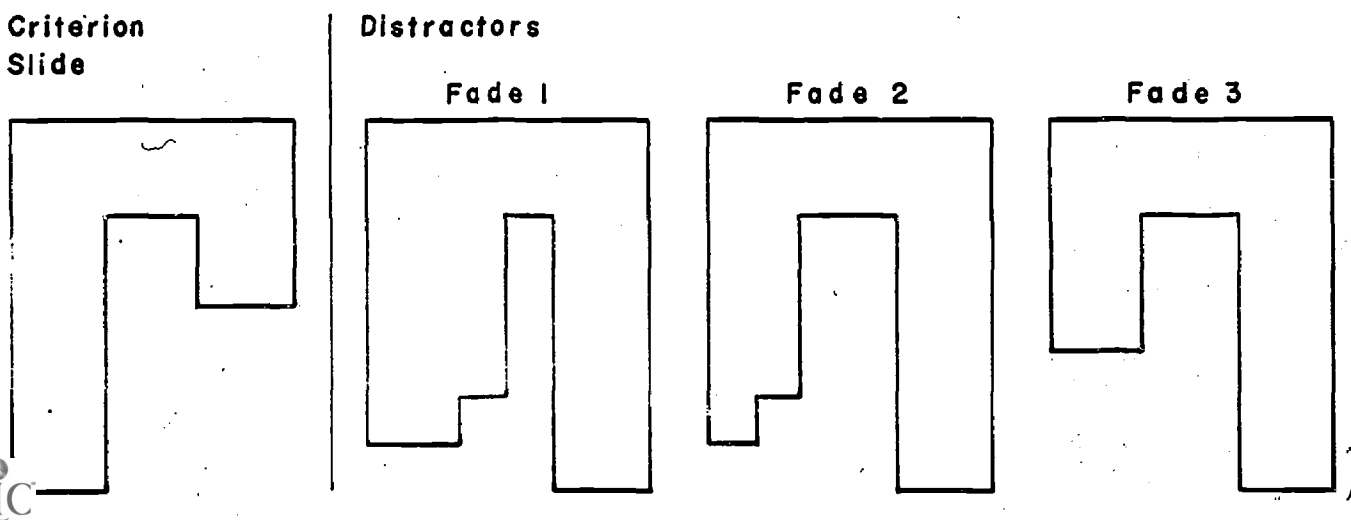
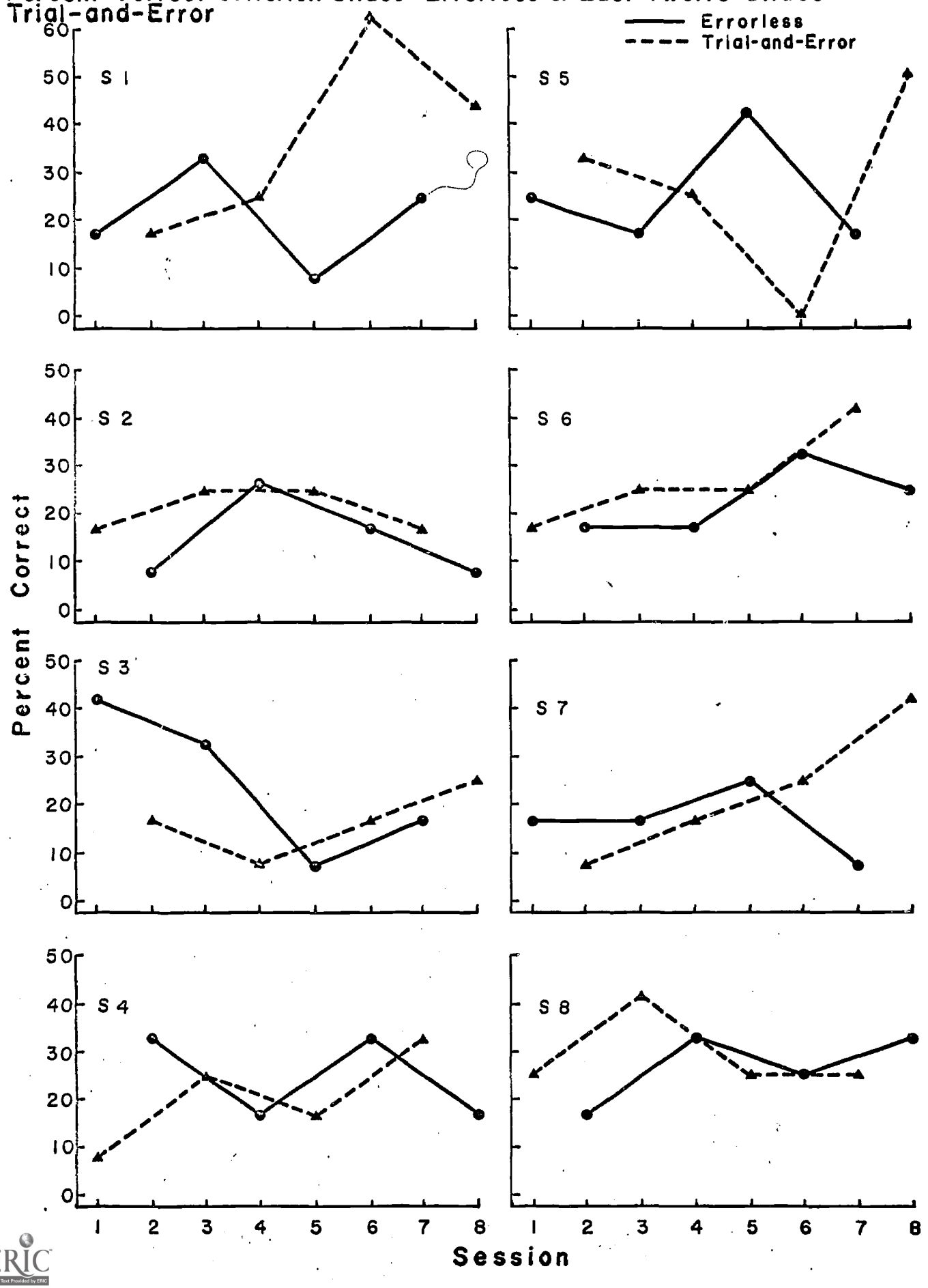


FIGURE 2


Percent Correct Criterion Slides-Errorless & Last Twelve Slides
Trial-and-Error
Errorless
Trial-and-Error
S 1
S 2
S 3
S 4
S 5
S 6
S 7
S 8
Percent Correct
Session
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8

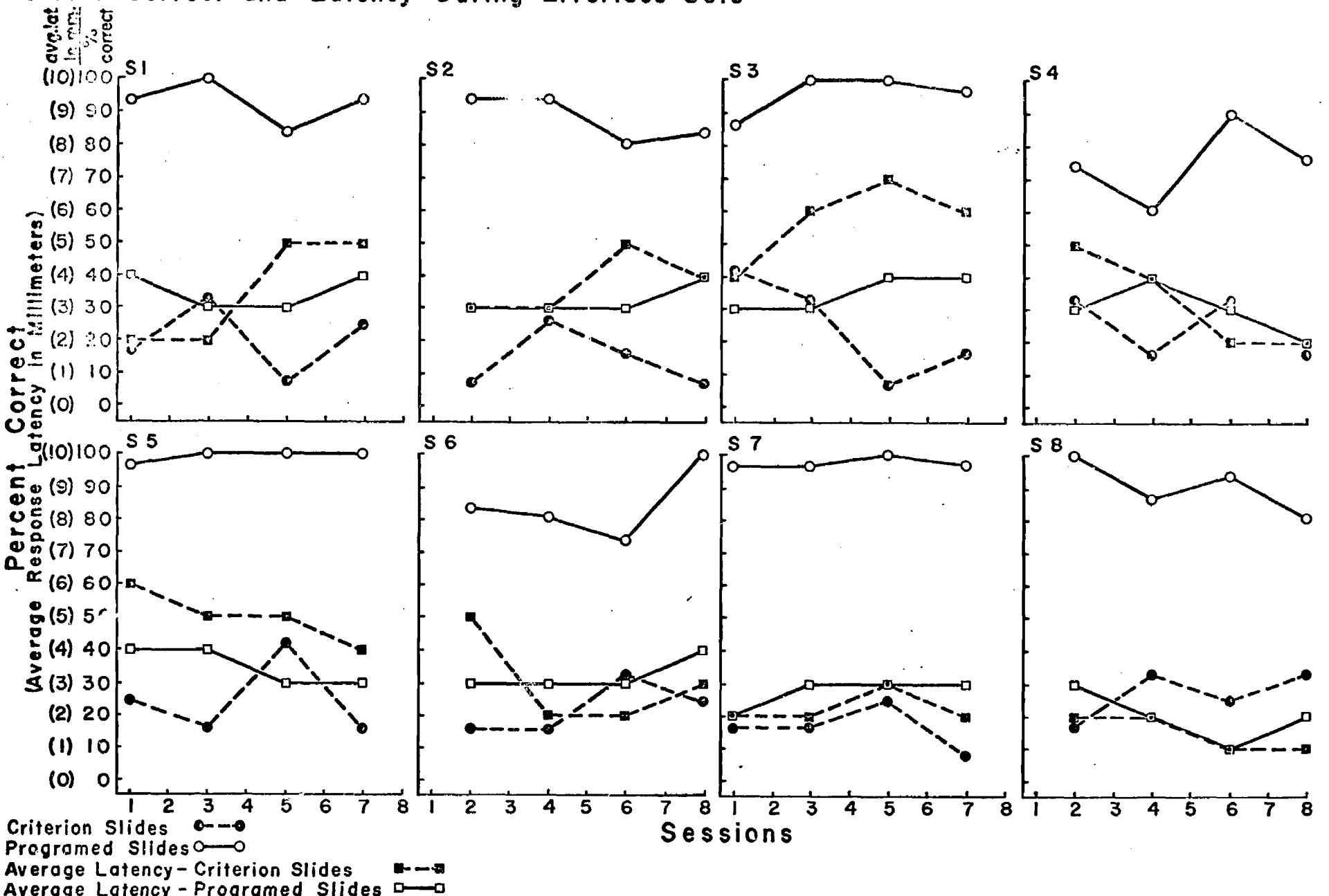


FIGURE 3